Claims
What is claimed is:

1. An emergency warning light comprising:

a heat sink;

a light engine adapted to be in thermal contact with the heat sink, the light engine including an array of LEDs generating light adapted for use as an emergency warning signal; and

a lens positioned adjacent the light engine for transmitting the light generated by the LEDs, the lens including a plurality of total internal reflection (TIR) surface configurations, each one of the TIR surface configurations corresponding to one of the LEDs of the array.

2. The light of claim 1 comprising a power supply circuit for energizing the light engine, the circuit adapted to be supported by the heat sink.

3. The light of claim 1 for use on a vehicle having a power source supplying a dc voltage and wherein the light engine comprises an LED series string array assembly, the light further comprising a power supply circuit adapted to be connected to the dc voltage, the power supply circuit comprising:

a step-up dc-dc voltage conversion circuit receiving the dc voltage and providing a stepped up dc voltage to the LED series string array assembly; and

a current feedback control circuit in series with the LED series string array assembly and providing feedback to the conversion circuit wherein the conversion circuit is responsive to the feedback for controlling the stepped up dc voltage as a function of the feedback; and

wherein the heat sink, the light engine, the lens and the power supply circuit for a unit adapted to be mounted on the vehicle.

4. The light of claim 3 further comprising a flash control circuit providing a flash control signal and wherein the current feedback circuit is responsive to the flash control signal for selectively energizing the LED series string array assembly to create a flashing emergency warning light signal.

5. The light of claim 1 wherein the light engine includes a heat absorbing substrate on which the array of LEDs is mounted and further comprising a thermal conducting pad between the substrate and the heat sink for transmitting heat generated by the array of LEDs and absorbed by the substrate to the heat sink.

6. The light of claim 1 wherein the heat sink includes a integral mounting portion adapted to engage a support structure on a vehicle.

7. The light of claim 1 further comprising a mounting bracket for supporting the heat sink, the light engine and the lens on a support structure on a vehicle.

8. The light of claim 1 wherein the TIR surface configurations each comprises a convex wall, an inner side wall and an outer side wall and wherein the lens comprises an injection molded material having at least on internal runner connected to the TIR surface configurations, the runner adapted to facilitate formation of the TIR surface configuration connected thereto during injection molding of the lens.

9. The light of claim 8 wherein the lens has opposing inner and outer surfaces, wherein the TIR surface configurations are on the inner surface facing the light engine and collect light generated by the LEDs of the light engine and wherein the outer surface comprises a distributing surface for distributing light collected by the TIR surface configurations.

10. The light of claim 1 wherein the lens has opposing inner and outer surfaces, wherein the TIR surface configurations are on the inner surface facing the light engine and collect light generated by the LEDs of the light engine and wherein the outer surface comprises a distributing surface for distributing light collected by the TIR surface configurations.

11. The light of claim 1 for use in a light bar having a support, the light bar adapted to be mounted on a vehicle, the emergency warning light comprising a module and wherein the heat sink is adapted to engage the support of the light bar.

12. The light of claim 11 wherein the heat sink includes an integral mounting portion connected to the support of the light bar and further comprising a power supply circuit for energizing the light engine, the circuit adapted to be supported by the heat sink.

13. The light of claim 12 further comprising:

a second light engine adapted to be in thermal contact with the heat sink, the second light engine including a second array of LEDs generating light adapted for use as an emergency warning signal; and

a second lens positioned adjacent the second light engine for transmitting the light generated by the LEDs of the second array, the second lens including a plurality of

second TIR surface configurations, each one of the second TIR surface configurations corresponding to one of the LEDs of the second array.

14. The light of claim 11 for use on a vehicle having a power source supplying a dc voltage and wherein the light engine comprises an LED series string array assembly, the light further comprising a power supply circuit adapted to be connected to the dc voltage, the power supply circuit comprising:

a step-up dc-dc voltage conversion circuit receiving the dc voltage and providing a stepped up dc voltage to the LED series string array assembly; and

a current feedback control circuit in series with the LED series string array assembly and providing feedback to the conversion circuit wherein the conversion circuit is responsive to the feedback for controlling the stepped up dc voltage as a function of the feedback; and

wherein the heat sink, the light engine, the lens and the power supply circuit for a unit adapted to be mounted on the vehicle.

15. The light of claim 11 further comprising a flash control circuit providing a flash control signal and wherein the current feedback circuit is responsive to the flash control signal for selectively energizing the LED series string array assembly to create a flashing emergency warning light signal.

16. The light of claim 11 wherein the lens has opposing inner and outer surfaces, wherein the TIR surface configurations are on the inner surface facing the light engine and collect light generated by the LEDs of the light engine and wherein the outer surface comprises a distributing surface for distributing light collected by the TIR surface configurations.

17. The light of claim 11 wherein the light engine includes a heat absorbing substrate on which the array of LEDs is mounted and further comprising a thermal conducting pad between the substrate and the heat sink for transmitting heat generated by the array of LEDs and absorbed by the substrate to the heat sink.

18. The light of claim 11 wherein the heat sink includes a integral mounting portion adapted to engage a support structure on a vehicle.

19. The light of claim 11 wherein the TIR surface configurations each comprises a convex wall, an inner side wall and an outer side wall and wherein the lens comprises an injection molded material having at least on internal runner connected to the TIR surface configurations, the runner adapted to facilitate formation of the TIR surface configuration connected thereto during injection molding of the lens.

20. The light of claim 11 for use on a vehicle having a power source supplying a dc voltage and wherein the light engine comprises an LED series string array assembly, the light further comprising a power supply adapted to be connected to the dc voltage for energizing the assembly, the power supply comprising a constant current step up power supply circuit.

21. A light bar for a vehicle comprising:
a support;
a first module comprising:
a heat sink adapted to engage the support of the light bar;
a light engine adapted to be in thermal contact with the heat sink, the light engine

including an array of LEDs generating light adapted for use as an emergency warning signal; and

a lens positioned adjacent the light engine for transmitting the light generated by the LEDs of the array, the lens including a plurality of TIR surface configurations, each one of the TIR surface configurations corresponding to one of the LEDs of the array; and

an enclosure enclosing the support and the first module, the enclosure adapted to be mounted on the vehicle.

22. The light bar of claim 21 wherein the module comprises a power supply circuit adapted to be supported by heat sink for energizing the light engine.

23. The light bar of claim 21 further comprising a power supply circuit within the enclosure for energizing the light engine.

24. The light of claim 21 for use on a vehicle having a power source supplying a dc voltage and wherein the light engine comprises an LED series string array assembly, the light further comprising a power supply circuit adapted to be connected to the dc voltage, the power supply circuit comprising:

a step-up dc-dc voltage conversion circuit receiving the dc voltage and providing a stepped up dc voltage to the LED series string array assembly; and

a current feedback control circuit in series with the LED series string array assembly and providing feedback to the conversion circuit wherein the conversion circuit is responsive to the feedback for controlling the stepped up dc voltage as a function of the feedback; and

wherein the heat sink, the light engine, the lens and the power supply circuit for a unit adapted to be mounted on the vehicle.

25. The light of claim 21 further comprising a flash control circuit providing a flash control signal and wherein the current feedback circuit is responsive to the flash control signal for selectively energizing the LED series string array assembly to create a flashing emergency warning light signal.

26. The light of claim 21 wherein the TIR surface configurations each comprises a convex wall, an inner side wall and an outer side wall and wherein the lens comprises an injection molded material having at least on internal runner connected to the TIR surface configurations, the runner adapted to facilitate formation of the TIR surface configuration connected thereto during injection molding of the lens.

27. The light bar of claim 21 further comprising:
a second module comprising:
a second heat sink adapted to engage the support of the light bar;
a second light engine adapted to be in thermal contact with the second heat sink, the second light engine including a second array of LEDs generating light adapted for use as a second emergency warning signal; and
a second lens positioned adjacent the second light engine for transmitting the light generated by the LEDs of the second array, the lens including a second plurality of TIR surface configurations, each one of the TIR surface configurations corresponding to one of the LEDs of the second array; and

wherein the enclosure encloses the support, the first module and the second module, the enclosure adapted to be mounted on the vehicle.

28. The light bar of claim 27 further comprising at least one power supply circuit within the enclosure for sequentially energizing the first and second light engines to produce a traffic direction directing signal.

29. The light bar of claim 27 wherein the first module comprises a first power supply circuit within the enclosure adapted to be supported by first heat sink for energizing the first light engine and wherein the second module comprises a second power supply circuit within the enclosure adapted to be supported by second heat sink for energizing the second light engine.

30. The light bar of claim 29 wherein the first and second power supply circuits sequentially energizes the first and second light engines, respectively, to produce a traffic direction directing signal.

31. The light bar of claim 27 further comprising a central power supply circuit within the enclosure for energizing the first and second light engines.

32. The light bar of claim 31 wherein the central power supply circuit sequentially energizes the first and second light engines to produce a traffic direction directing signal.

33. The light of claim 21 wherein the light engine includes a heat absorbing substrate on which the array of LEDs is mounted and further comprising a thermal conducting pad between the substrate and the heat sink for transmitting

heat generated by the array of LEDs and absorbed by the substrate to the heat sink.

34. The light of claim 21 wherein the TIR surface configurations each comprises a convex wall, an inner side wall and an outer side wall and wherein the lens comprises an injection molded material having at least on internal runner connected to the TIR surface configurations, the runner adapted to facilitate formation of the TIR surface configuration connected thereto during injection molding of the lens.

35. The light of claim 21 wherein the lens has opposing inner and outer surfaces, wherein the TIR surface configurations are on the inner surface facing the light engine and collect light generated by the LEDs of the light engine and wherein the outer surface comprises a distributing surface for distributing light collected by the TIR surface configurations.

36. An emergency warning light for use on a vehicle comprising:

a support adapted to be a heat sink;

a light engine adapted to be in thermal contact with the support, the light engine including an array of LEDs generating light adapted for use as an emergency warning signal;

a lens positioned adjacent the light engine for transmitting the light generated by the LEDs of the array, the lens including a plurality of TIR surface configurations, each one of the TIR surface configurations corresponding to one of the LEDs of the array;

a power supply circuit for energizing the light engine; and

an enclosure enclosing the support, the light engine, the power supply and the lens, the enclosure adapted to be mounted on the vehicle.

37. The light of claim 36 further comprising a transparent cover positioned adjacent and spaced from the first lens and supported by the enclosure for transmitting light transmitted by the first lens.

38. The light of claim 36 further comprising:

a second light engine adapted to be in thermal contact with the support, the second light engine including a second array of LEDs generating light adapted for use as an emergency warning signal;

a second lens positioned adjacent the second light engine for transmitting the light generated by the LEDs of the second array, the second lens including a second plurality of second TIR surface configurations, each one of the second TIR surface configurations corresponding to one of the LEDs of the second array;

wherein the power supply circuit energizes the second light engine and wherein the enclosure encloses the support, the light engine, the power supply, the lens, the second light engine and the second lens, the enclosure adapted to be mounted on the vehicle.

39. The light of claim 38 further comprising:

a third light engine adapted to be in thermal contact with the support, the third light engine including a third array of LEDs generating light adapted for use as an emergency warning signal;

a third lens positioned adjacent the third light engine for transmitting the light generated by the LEDs of the third array, the third lens including a third plurality of third TIR surface configurations, each one of the third TIR

surface configurations corresponding to one of the LEDs of the third array;

wherein the power supply circuit selectively, sequentially energizes the first, second and third light engines to provide a traffic direction directing visual signal and wherein the enclosure encloses the support, the light engine, the power supply, the lens, the second light engine, the second lens, the third light engine and the third lens, the enclosure adapted to be mounted on the vehicle.

40. The light of claim 31 further comprising a bracket adapted to engage the light and the vehicle for supporting the light on the vehicle.

41. The light of claim 36 comprising a power supply circuit for energizing the light engine, the circuit adapted to be supported by the support.

42. The light of claim 36 for use on a vehicle having a power source supplying a dc voltage and wherein the light engine comprises an LED series string array assembly, the light further comprising a power supply circuit adapted to be connected to the dc voltage, the power supply circuit comprising:

a step-up dc-dc voltage conversion circuit receiving the dc voltage and providing a stepped up dc voltage to the LED series string array assembly; and

a current feedback control circuit in series with the LED series string array assembly and providing feedback to the conversion circuit wherein the conversion circuit is responsive to the feedback for controlling the stepped up dc voltage as a function of the feedback; and

wherein the light engine, the lens and the power supply circuit form a unit adapted to be mounted on the vehicle.

43. The light of claim 36 further comprising a flash control circuit providing a flash control signal and wherein the current feedback circuit is responsive to the flash control signal for selectively energizing the LED series string array assembly to create a flashing emergency warning light signal.

44. The light of claim 36 wherein the light engine includes a heat absorbing substrate on which the array of LEDs is mounted and further comprising a thermal conducting pad between the substrate and the support for transmitting heat generated by the array of LEDs and absorbed by the substrate to the support.

45. The light of claim 36 wherein the lens has opposing inner and outer surfaces, wherein the TIR surface configurations are on the inner surface facing the light engine and collect light generated by the LEDs of the light engine and wherein the outer surface comprises a distributing surface for distributing light collected by the TIR surface configurations.

46. The light of claim 36 wherein the TIR surface configurations each comprises a convex wall, an inner side wall and an outer side wall and wherein the lens comprises an injection molded material having at least on internal runner connected to the TIR surface configurations, the runner adapted to facilitate formation of the TIR surface configuration connected thereto during injection molding of the lens.